

Commutative Properties of Addition and Multiplication

For all Real Numbers a & b:

$$a + b = b + a$$

$$a \cdot b = b \cdot a$$

Example

$$5 + 7 = 7 + 5$$

$$2 \cdot 9 = 9 \cdot 2$$

Are the values of the expressions the same?

$$12 = 12$$

Yes

$$18 = 18$$

Can we apply the same logic to Subtraction and Division?

Associative Properties of Addition and Multiplication

For all Real Numbers a, b & c:

$$(a + b) + c = a + (b + c)$$

$$(a \cdot b) \cdot c = a \cdot (b \cdot c)$$

Example

$$(5 + 7) + 4 = 5 + (7 + 4)$$

$$(2 \cdot 9) \cdot 6 = 2 \cdot (9 \cdot 6)$$

Are the values of the expressions the same?

$$16 = 16$$

Yes

$$108 = 108$$

Can we apply the same logic to Subtraction and Division?

Distributive Property

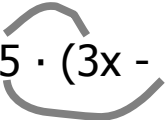
$$a \cdot (b + c) = ab + ac$$

$$a \cdot (b - c) = ab - ac$$

Example

$$5 \cdot (3x - 2) = 15x - 10$$

$$9 \cdot (2x + 1) = 18x + 9$$

 $5 \cdot (3x - 2)$ Multiply 5 times 3x minus 5 times 2

or

$5 \cdot (3x - 2)$ Multiply 5 times 3x plus 5 times a negative 2

Identity Property of Addition

For all Real Numbers a:

$$\mathbf{a + 0 = a}$$

Zero is the identity element for Addition.

Inverse Property of Addition

$$\mathbf{a + -a = 0}$$

"Additive inverse" is another name for "Opposite"